



Profitability Evaluation and Ranking of Indian Non-Life Insurance Firms using GRA and TOPSIS

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ABSTRACT

This paper evaluates the profitability of the Indian non-life insurance firms in the period 2008-2013 using multi criteria decision analysis methods: GRA and TOPSIS based on the profitability ratios. Also, ranking of the non-life insurance firms is arrived. Few studies on efficiency of Indian non-life insurance firms using different DEA models were studied, but the number of inputs and outputs considered are very few as the DEA convention doesn't allow number of DMUs more than three times the sum of inputs and outputs. But, the profitability evaluation involves more number of decision variables considered in efficiency studies using DEA models. This paper addresses this gap by evaluating the profitability of nonlife insurance firms with more number of decision variables or criteria using Multi-Criteria Decision Analysis: GRA and TOPSIS.

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1. Introduction

Post 2007, the Indian insurance industry is faced with twin challenges: economic recession and lower margins due to freeing up of premium rates. The economic slowdown in India has led to a quick reduction in asset creation in the Indian market. This along with meticulous cost cutting measures in all businesses has directly impacted the non-life insurance industry in India. The key reason for the fall in insurance business was that many small and medium businesses either did not buy insurance covers or bought lower cover to save on premium payment. Also the sharp drop in sales of vehicles led to a big fall in insurance premium. One of the most important step in the Indian non-life insurance industry has been the de-tariffication started after January 2007. De-tariffication has led to fall of product prices, tough competition in the market, and increase in higher cost of running the business and better service to customer. The growth in premiums in the non-life insurance industry has slowed down post de-tariffication (Economic Survey 2008-09). In this connection, the profitability of the Indian non-life insurance firms during the period 2008-13 has been evaluated in this chapter. But, profitability evaluation involves more number of parameters than the sum of number of inputs and outputs considered in earlier studies of efficiency and productivity of non-life insurance firms using different DEA models as the DEA convention doesn't allow number of DMUs more than three times the sum of inputs and outputs as stated by Charnes and Cooper [2]. Hence to evaluate the alternatives firms with more number of decision variables or criteria, one of the approach is employing Multi-Criteria Decision Analysis (MCDA) or Multi-Criteria Decision making (MCDM) techniques. The heart of operations research (OR) lies in the development of techniques for optimal decision making. A well-known class of such techniques is multi-criteria decision making or analysis (MCDM or MCDA). The characteristic of a MCDM problem is the evaluation of a set of alternatives in terms of a set of decision criteria. Since 1970s, MCDA has evolved as an important subject of Operations Research. MCDM as defined by the International Society of MCDM is the study of methods and procedures that deals with decision situations where the decision maker has several conflicting objectives. Valerie et al (1999) says that DEA could be considered as a technique which seeks to obtain as much as possible from the objective historical data without using any subjectivity. Whereas, MCDA actively seeks to obtain and understand, manage value judgements. It has been suggested by Belton and Stewart (1999) that DEA is a suitable method for monitoring and control, whereas MCDA is most suitable in the context of evaluation and choice as MCDM problem is defined on a set of the alternatives from which a

decision maker has to select the optimal alternative according to some criteria. Joro et al (1998) says that the methodological framework of efficiency analysis using DEA has significant similarities but notable differences with the framework of MCDA.

There are considerable numbers of studies on performance evaluation of financial institutions using parametric techniques like stochastic techniques and non- parametric methods such as DEA apart from financial statement analysis with associated financial ratios, but hardly any studies in India on profitability evaluation and ranking of non-life insurance firms using the methods of Grey Relational Analysis (GRA) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

In this paper, the profitability of the Indian non-life insurance firms during the period 2008-13 has been evaluated using two MCDA techniques: Grey Relational Analysis (GRA) and The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS).

The remainder of this paper is structured as follows: The next section 2 gives an overview of related literature. This section is followed by Section 3 that defines the terminology used. Section 4 develops the problem under study along with the proposed model, and Section 5 illustrates the model in a numerical example. The last section presents a summary of the most important findings of this work and suggestions for future research.

2. Literature Review

Elitaş et al. (2012) determined financial performances of insurance firms the years 2010-2011 by using GRA. 10 financial ratios have been used in the study and performance measurement has been carried out using of liquidity, leverage and profitability ratios.

Peker and Baki (2011) aimed to rank the financial performance of insurance companies with GRA for the year 2008. They concluded that a firm which has high liquidity ratios may have high performance.

Chang et al (2006) studied the performance of 16 non-life insurance companies with of financial ratios and operation indicators as the performance evaluation variables. They are capital structure, profitability, solvency, management efficiency and capital operational capability. This study used the grey relational analysis (GRA) to provide an estimative model on the operating performance of non-life insurance companies. Conclusions indicate that both return on assets and sign of profitability influence heavily financial ratio as well as operating index on performance.

Sakinc (2014) studied the Performances of State-owned banks in Turkish Banking Sector with grey relational analysis (GRA) method. In the analysis, four years of financial data is used related with banks between 2010-2013 years. These data were analyzed by 15 ratios which determine; capital adequacy, liquidity, asset quality and profitability criteria.

Dogan (2013) measured and compared financial performances of 10 banks with common stock trading in Istanbul Stock Exchange (ISE) between the years of 2005–2011 using GRA. Performances of 10 banks have been analyzed in the study with the help of ratios of liquidity, asset quality, leverage and profitability.

Nuray and Nurullah (2012) studied to identify the impacts of the financial crisis in the performances of the Turkish commercial banks by their ownership structures (private or public) over the years between 2005 and 2009 by using Grey Relation Analysis (GRA) method and to determine their financial performances. A 5-year period including the year of the crisis as well as two years before and after the financial crisis. The banks, by their capital structures, are ranked based on their performances by using GRA method with 14 financial ratios with respect to profitability, liquidity, active quality and capital sufficiency. Based on the results, the performance ranking has been changed from foreign-public-private banks before the crisis (2005-2006) to private-foreign-public banks during the crisis (2008-2009).

Saeed.et.al. (2013) developed an evaluation model taking the indicators identified in the assessment of seven insurance companies in the ranking and weighting these criteria and companies, the AHP and TOPSIS method has been used. The results have given an ideal ranking, which can be used in future research with larger population.

Hemmati (2013) studied the relative efficiencies of 16 private and governmental banks in terms of electronic payment. This paper used the data of one of Iranian provinces and the results from DEA and TOPSIS have indicated that 9 out of 16 banks were efficient. Our study also indicates that mean of relative efficiency for private banks was 82% while 75% for governmental banks.

Wang (2008) studied the evaluation weights are determined using Analytic Network Process (ANP) along with the Delphi method. Finally, the technique for ordering preference by similarity to the ideal solution (TOPSIS) constructs performance evaluation model of property-liability insurance companies in Taiwan. This research use financial statements of property-liability insurance industry and calculated the efficiency.

Hasanloo.et.al. (2013) designed a model to evaluate the performance of companies in the stock market by using TOPSIS and sensitivity analysis and financial ratios as criteria in TOPSIS algorithm.

Roghayyeh Shahbazi Alenjagh (2013) studied the performance of insurance firms in Tehran Stock Exchange using seventeen key financial ratios related to performance evaluation and then by using the ANP along with PROMETHEE technique, companies were ranked based on financial performance.

Mehrzaad et.al. (2013) identified key indices to appraise and rate agency companies using balanced scorecard and weighted every index using AHP and finally rate the Iran- agency insurance companies in Isfahan province companies according to two SAW and TOPSIS models.

Khodamoradi (2014) applied PROMETHEE II technique along with DEMATEL to identify important criteria in the rating process. It was observed that Alborz Company has the highest and Dana Company has the lowest rate.

3. Prerequisite Concepts

3.1 Profit and Profitability

Profit is an excess of income over associated expenses for an activity over a period of time. Lord Keynes says that 'Profit is the engine that drives the business organisation'. Also, Profit is the key reason for the continued existence of every business organisation.

Profitability is defined as the ability of an insurance company to exceed its overall revenue from its total expenses which results in profit generation. It shows how efficiently the organisation can make profit by consuming all the resources available. Also, organisation's efficiency is measured by the profitability of the organisation and is regarded as a measure of efficiency and organisation guide to higher levels of efficiency. But, the term 'Profitability' is not identical to the term 'Efficiency'. Though, profitability is an important index for measuring the efficiency, the size of profitability cannot be taken as a final evidence of efficiency. Sometimes reasonable profits can mark inefficiency and conversely, a proper level of efficiency can be without profit. The net profit number simply tells a satisfactory sense of balance between the values receive and value given. The change in operational efficiency is just one of the factors on which profitability of an organisation largely depends. Moreover, there are many other things other than efficiency, which influence the profitability.

3.1.1 Profitability Drivers of Insurance Firms

Profit can be given as the following basic equation:

Profit = Premium – Incurred Loss – Expenses + Investment Income = UW Profit + Investment Income.

Hence, the two main sources of profit for insurance firms are underwriting profit (UW Profit) and investment income. Underwriting profit also known as operating income, is the sum of the profits generated from the individual policies and is similar to the profit as defined in most other industries (i.e., income minus outgo). Underwriting profit is determined by underwriting performance of the insurance firm, which again is a function of changes in losses, overall expenses, product pricing, risk selection, better claims management and control.

Investment income is the income generated by investing funds held by the insurance firm. Investment income is determined by the investment performance of the insurance firm, which is again a function of overall asset management, allocation and leverage.

3.1.2 Ratios for Profitability Evaluation

Profitability performance of the non-life insurance firms has been evaluated using the following ratios.

1. Incurred Claim Ratio or Loss Ratio (LR=Net Incurred Claims/Net Written Premium)

The Incurred Claim Ratio indicates what percentage of premiums is being used to fund losses and their settlement. **The lower the Incurred Claim Ratio the better.** Higher Incurred Claim Ratios may indicate that an insurance firm may need better control over the claims and better risk management in underwriting the policies to safeguard against future loss payouts.

2. Expense Ratio(ER=Management expenses/Net Written Premium)

The expense ratio indicates what proportion of an insurer's written premium is being used to pay acquisition costs, general management expenses and premium taxes. In other words, this ratio indicates the insurer's general cost of doing business as a proportion of the premium it has written (Investment expenses are not part of either loss ratio or the expense ratio).The expense ratio gives a general picture of how efficiently the insurer is operating. Insurance firms watch the expense ratio carefully over time and attempt to reduce it by managing cash flow and controlling expenses. **The lower the expense ratio the better** because it means more profits to the insurance firm.

3. Combined Ratio ((CoR=Net Incurred Claim + Expenses)/Net Written Premium)

The combined ratio is a primary measure of the profitability of the book of business. While the combined ratio is considered the accepted measure of an insurer's underwriting performance, this ratio does not take into account the insurer's investment income and hence it does not measure the insurer's overall financial performance. Overall financial performance includes the results from both the insurer's underwriting activities and its investment activities. **The lower the combined ratio, the better.** Most insurance firms consider a combined ratio below 100% to be acceptable, because it indicates a profit from underwriting, even before investment income is considered. In fact many insurance firms regularly experience a combined ratio over 100% and attempt to offset underwriting losses with investment income.

4. Underwriting Profitability or Underwriting Results Ratio ((URR=Net Written premium-Net Incurred Claims-Expenses-increase in unexpired risk reserve)/Net Written Premium)

This ratio reveals how profitable the insurance firm's policies have been after subtracting the costs of issuing the policies. The underwriting results ratio indicates the firm's performance from the core insurance business. **The higher the underwriting results ratio, the better.**

5. Net Retention Ratio (NRR=Net Written Premium/Gross Written Premium)

Net Retention Ratio is a rough measure of how much of the risk is being carried by an insurer rather than being passed to reinsurers. What it measures directly is how much of the premium is retained rather than passed on, its use as a measure of risk carried assumes that premium is proportional to risk. The net retention ratio indicates the extent the insurer is retaining premium. Net Retention ratio shows the risk bearing capacity of an insurance company. The level of retention ratio is normally based on the insurer's own capital strength. Firms with stronger capital are able to retain more premium whereas the companies with lower capital usually pass the risk to reinsurer because of their lower capacity to absorb risks arising from catastrophic or large losses.

If more than 50% of gross premium are ceded out, it implies over reliance on reinsurance. In other words, the insurance firm is not effectively using underwriting expertise. Insurance firm is at the risk if the reinsurer reduce their obligation or withdraw their support altogether in difficult times due to the adverse situations in the reinsurance market. On the other hand, if the insurer retains too much risk, then there may be a chance that the insurer might be

strained due to catastrophe or large losses. The optimal level of retention ratio depends on the risk bearing capacity and experience of the insurance firm. Considering the issues with the levels of net retention ratio, it is suggested to have **moderate level of net retention ratio**.

6. Investment Income Ratio($IRR = \text{Investment Income} / \text{Net Written Premium}$)

Insurance companies invest premiums in order to generate a profit. The investment income ratio compares the income that an insurance company earns from its investment decisions rather than its operations. The investment income ratio indicates the degree of success achieved in the insurer's investment activities. **The higher the investment income ratio, the more successful** are the insurer's investment activities.

7. Overall Operating Ratio($OR = \text{Combined Ratio} - \text{Investment Income Ratio}$)

The overall operating ratio can be used to provide an overall measure of the financial performance of the insurance firm. Of all the commonly used ratios, the overall operating ratio is the most complete measure of insurance firm's profitability. **An overall operating ratio of less than 100% indicates an overall operating gain** because revenues are greater than total expenses. An overall operating ratio of more than 100% indicates that the insurance firm is unable to make profits from its underwriting and investment activities.

8. Net Earnings Ratio($NER = \text{Profit after tax} / \text{Net Written Premium}$)

Net earnings ratio is one of the most important measures of a firm's performance, since the quest for earnings is the key reason for organisation's existence. It explains how much earning is gained in comparison to net premium. Thus, Net Earnings Ratio shows the profitability of the business operation in an insurance industry. The **higher net earnings ratio** shows the higher earning power of an insurance company and good financial health.

9. Return on Equity Ratio($ROE = \text{Profit after tax} / \text{Net Worth}$)

The return on equity (ROE) ratio explains how much profit a business generated in comparison to shareholders' capital. ROE ratio indicates the performance of an insurance company relative to the net worth. ROE ratio is measure of efficiency than a measure of profit. A higher ROE ratio suggests that the firm is increasing its ability to generate profit without much capital. It also indicates how well a firm's management is deploying the shareholders' capital. In other words, the **higher the ROE ratio the better**. The higher return shows higher profitability and better financial health of an insurance company.

4. Methodology: MCDA Models: GRA and TOPSIS

4.1 Grey Relational Analysis (GRA)

Using traditional statistical techniques to measure and evaluate the performance has some limitations, such as the requirement of large number of data to fit the normal distribution hypothesis. Deng (1982) has introduced Grey System to overcome these limitations, as it can handle effectively with small sample, data with uncertainty, multi-inputs. Grey relational analysis (GRA) is one of the derived methods based on the concept of Grey System for evaluation of alternatives with multi-criteria.

4.1.1 Procedure of GRA

The calculation steps of gray relational analysis method are shown below (Wen, 2000).

Step 1: Formation of Decision matrix

Let the number of non-life insurance firms be m and the number of profitability evaluation criteria be n . Then a $m \times n$ decision matrix is given by

$$X = \begin{bmatrix} x_1(1), x_1(2), \dots, x_1(n) \\ x_2(1), x_2(2), \dots, x_2(n) \\ \dots \\ \dots \\ x_m(1), x_m(2), \dots, x_m(n) \end{bmatrix} \quad (1)$$

where $x_i(k)$ is the value of the j^{th} criteria of the i^{th} insurance firm.

Step2: The identification of reference series (ideal target sequence)

The reference sequence is given as $X_0 = \{x_0(1), x_0(2), \dots, x_0(n)\} = (1, 1, \dots, 1, \dots, 1)$, where $x_0(j)$ is the reference value for j^{th} attribute.

Step 3: Decision Matrix Normalization

The determination of the type of formula to be employed for data normalization is based on the characteristics of a data sequences, as follows:

1). If the expectation is the larger-the-better (i.e. beneficial attribute), then the formula for normalisation of the data is given by

$$x^*(k) = \frac{[x_i^0(j) - \min x_i^0(j)]}{[\max x_i^0(j) - \min x_i^0(j)]} \quad (2)$$

2).If the expectation is the smaller- the- better (i.e. non-beneficial or cost attribute), then the formula for normalisation of the data is given by

$$x^*(k) = \frac{[\max x_i^0(j) - x_i^0(j)]}{[\max x_i^0(j) - \min x_i^0(j)]} \quad (3)$$

3).If the expectation is the nominal-the-best (i.e. observed value or target value or an average value or moderate value), then the formula for normalisation of the data is given by

$$x^*(k) = \frac{abs[x_i^0(j) - \min x_i^0(j)]}{\max\{[\max x_i^0(j) - x_{ob}(j)], [x_{ob}(j) - \min x_i^0(j)]\}} \quad (4)$$

Where $i = 1 \dots m; j = 1 \dots n$.

m is number of alternatives entities(number of insurance firms in this work)

n is the number of attributes(number of financial ratios considered in this work)

$x_i^0(j)$ is the original sequence,

$x_i^*(j)$ is the sequences after data pre-processing,

$\min x_i^0(j)$ and $\max x_i^0(j)$ are the smallest and the largest value of $x_i^0(j)$

$x_{ob}(j)$ is the observed or target value

In comparability sequence, all performance values are scaled to $[0, 1]$. For an attribute k of alternative i , if the value $x^*(j)$ which has been processed by data pre-processing procedure is equal to 1 or nearer to 1 than the value for any other alternative, then the performance of alternative i is considered as best for the attribute j .

From the above normalization steps, the decision matrix in (1) becomes as shown below:

$$X_i^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \dots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \dots & x_2^*(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_m^*(1) & x_m^*(2) & \dots & x_m^*(n) \end{bmatrix} \quad (5)$$

Step 4: The formation of absolute value matrix

The absolute value is absolute difference between the reference and the comparison series
That is, $\Delta_{oi}(j)$ is the absolute difference between $x_o^*(j)$ and $x_i^*(j)$ and is determined as below:

$$\Delta_{oi}(j) = |x_{oi}^*(j) - x_i^*(j)| \quad (6)$$

$$\begin{bmatrix} \Delta_{o1}(1) & \Delta_{o1}(2) & \dots & \Delta_{o1}(n) \\ \Delta_{o2}(1) & \Delta_{o2}(2) & \dots & \Delta_{o2}(n) \\ \vdots & \vdots & \ddots & \vdots \\ \Delta_{om}(1) & \Delta_{om}(2) & \dots & \Delta_{om}(n) \end{bmatrix}$$

Step 5: The formation of grey relational coefficient matrix

$$\gamma_{m \times n} = [\gamma_{oi}(j)]$$

where

$$\gamma_{oi}(j) = (\Delta_{\min} + \Delta_{\max}) / (\Delta_{oi}(j) + \Delta_{\max}) \quad (7)$$

where

$$\Delta_{\min} = \min_i \{ \min_j \{ \Delta_{oi}(j) \} \} \text{ and } \Delta_{\max} = \max_i \{ \max_j \{ \Delta_{oi}(j) \} \} \text{ for all } i = 1 \dots m; j = 1 \dots n$$

These grey relational coefficients can be used to evaluate the profitability of the insurance firms.

Step 6: The calculation of grey relational grade (GRG)

$$\Gamma_{oi} = \frac{1}{n} \sum_{j=1}^n \gamma_{oi}(j) \quad (8)$$

for all $i = 1 \dots m; j = 1 \dots n$

The grey relational grade indicates the degree of similarity between the comparability sequence and the reference sequence. If an alternative gets the highest grey relational grade with the reference sequence, it means that comparability sequence is most similar to the reference sequence and that alternative would be the best choice (Fung (2003)).

Step 7: Determination of Rank based on the Γ_{oi} for each of the alternative insurance firms. Using Γ_{oi} values, order or rank for each of the alternative insurance firms can be determined

4.2. TOPSIS

The Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method, a branch of MCDM methods, is applied to rank the Indian non-life insurance firms.

A MCDM problem can be concisely expressed in a matrix format, in which rows indicate competing alternatives and columns indicate criteria considered in a given problem. More clearly, a MCDM problem with m alternatives (A_1, A_2, \dots, A_m) that are evaluated by n criteria (C_1, C_2, \dots, C_n) can be treated as a geometric system with m points in n -dimensional space.

An element x_{ij} of the matrix indicates the performance rating of the i^{th} alternative A_i , with respect to the j^{th} criterion C_j , as shown in the following Equation (1)

$$D = \begin{matrix} & \begin{matrix} C_1 & C_2 & C_3 & \cdots & C_n \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2n} \\ x_{31} & x_{32} & x_{33} & \cdots & x_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & x_{m3} & \cdots & x_{mn} \end{bmatrix} \end{matrix} \quad (1)$$

TOPSIS method has been introduced by Hwang and Yoon [1981] and is based on the idea that the best alternative should have the shortest distance from the positive ideal solution and farthest distance from the negative ideal solution.

4.2.1 Procedure of TOPSIS

The TOPSIS solution method consists of the following steps (Ahi.et al (2009))

Step 1: Normalizing the decision matrix D

The decision matrix D is normalized done using the following transformation, for each x_{ij}

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}, \quad i = 1, \dots, m; \quad j = 1, \dots, n.$$

Step 2: Determining the normalized weighted decision

The columns of the normalized decision matrix from the step1 are multiplied by the corresponding weights as follows

$$v_{ij} = w_j \cdot n_{ij} \quad \text{for } i = 1, \dots, m; j = 1, \dots, n$$

where w_j represents the weight of j^{th} criterion and

$$\sum_{j=1}^n w_j = 1$$

Weight w_j for each criterion j is determined using the information entropy weighting method as presented below:

The weight of the criterion explains its significance in MCDA. In this work, an objective weight known as Information Entropy Weight (IEW) is applied based on the information entropy theory (Zang (2011)). Standardization was done to transform different scales and units among different criteria into common measurable units in order to compare their weights.

$$x'_{ij} = \frac{x_{ij} - \min_{1 \leq j \leq n} x_{ij}}{\max_{1 \leq j \leq n} x_{ij} - \min_{1 \leq j \leq n} x_{ij}}$$

$D' = (x')_{m \times n}$ is the matrix after standardization $\max x_{ij}$, $\min x_{ij}$ are the maximum and the minimum value of the criterion (j) respectively, all values in D' are ($0 \leq x'_{ij} \leq 1$)

Using the normalized matrix $D' = (x')_{m \times n}$, the information entropy is determined as mentioned in the following steps:

$$f_{ij} = \frac{1 + x'_{ij}}{\sum_{i=1}^m (1 + x'_{ij})}$$

$$H_j = - \left(\sum_{i=1}^m f_{ij} \ln f_{ij} \right) \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n$$

After calculating the variation degree (H_j), the deviation degree of the criterion (j) noted by (G_j) is calculated as follows

$$G_j = 1 - H_j \quad \text{for } j = 1, \dots, n$$

It is evident that (G_j) is greater if the value of (H_j) is smaller, consequently if the (G_j) is lower, the information entropy (H_j) is higher, which says that the more the information

criterion (j) provides, the greater weight given to the criterion (j). The weight (W_j) of the criterion (j) is defined as:

$$w_j = \frac{G_j}{\sum_{j=1}^n G_j} = \frac{1 - H_j}{n - \sum_{j=1}^n H_j}$$

where $j = 1, 2, \dots, n$.

Step 3: Determining the positive and negative ideal solutions

$$A^+ = (v_1^+, v_2^+, \dots, v_n^+) = \{(\max_j v_{ij} | j \in \Omega_b), (\min_j v_{ij} | j \in \Omega_c)\},$$

$$A^- = (v_1^-, v_2^-, \dots, v_n^-) = \{(\min_j v_{ij} | j \in \Omega_b), (\max_j v_{ij} | j \in \Omega_c)\},$$

where Ω_b is the set of benefit criteria and Ω_c is the set of cost criteria

Step 4: Measuring the distance from positive and negative ideal solutions

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2}, \quad i = 1, 2, \dots, m,$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}, \quad i = 1, 2, \dots, m,$$

where S_i^+ and S_i^- represents the distance of alternative A_i from the positive and negative ideal solutions, respectively

Step 5: Calculating the relative closeness (RC) to the ideal solution

The relative closeness (RC) to the ideal solution is defined as follows

$$RC_i = \frac{S_i^-}{S_i^+ + S_i^-}, \quad i = 1, 2, \dots, m, \quad 0 \leq RC_i \leq 1,$$

where RC_i represents the relative closeness.

Step 6: Ranking the alternatives

Alternatives must be ranked based on RC_i value in which the highest score is the best alternative

5. Methodology and Results

5.1 Profitability Analysis

The actual profitability ratios for evaluation of Indian non-life insurance firms and associated findings are discussed in this section. Overall financial year averages of profitability ratios by public and private are given below

Table 1: Averages of profitability ratios by firm

Average/Firm Name	LR	ER	CoR	IIR	NRR	OR	NER	ROE	URR
BA	69.7%	29.0%	98.7%	12.4%	79.7%	86.3%	5.3%	14.2%	-5.9%
BAX	55.1%	128.3%	183.4%	17.4%	69.1%	166.0%	122.8%	26.8%	-480.4%
CMS	66.1%	30.4%	96.5%	10.2%	72.2%	86.3%	1.1%	3.3%	-9.9%
FG	63.7%	47.1%	110.8%	10.0%	69.5%	100.7%	-27.2%	20.5%	-60.9%
HE	68.2%	27.4%	95.6%	11.7%	61.2%	83.9%	-5.4%	-5.4%	-13.7%
IL	84.2%	22.8%	107.0%	15.5%	70.2%	91.5%	0.4%	-6.2%	-15.6%
IT	77.0%	36.1%	113.1%	12.5%	69.4%	100.6%	1.0%	2.5%	-11.9%
RG	92.7%	33.7%	126.4%	13.2%	72.2%	113.3%	-13.9%	13.3%	-27.3%
RS	67.4%	33.2%	100.6%	11.4%	83.8%	89.2%	1.4%	4.0%	-10.4%
SRG	48.3%	19.9%	68.2%	11.9%	61.2%	56.4%	4.2%	14.0%	-4.8%
TAG	64.3%	38.8%	103.1%	14.1%	72.8%	89.0%	1.2%	2.5%	-12.4%
US	49.3%	72.2%	121.5%	29.7%	73.1%	91.8%	-33.1%	14.0%	-764.9%
Mean Private	67.2%	43.3%	110.4%	14.2%	71.2%	96.2%	-15.6%	-3.8%	-118.2%
Nnl	83.5%	30.8%	114.3%	29.5%	86.2%	84.8%	3.3%	2.2%	-24.3%
NI	84.2%	35.2%	119.5%	30.5%	86.2%	88.9%	4.4%	1.6%	-29.2%
Orntl	91.9%	35.8%	127.7%	32.7%	82.1%	95.0%	0.5%	0.5%	-29.6%
UI	79.6%	33.3%	112.9%	31.7%	81.2%	81.2%	9.2%	5.7%	-22.8%
Mean Public	84.8%	33.8%	118.6%	31.1%	83.9%	87.5%	4.3%	2.5%	-26.5%

Table 2: Averages of by ratio by year by firm type

Ratio	Sector Type /FY	2008-09	2009-10	2010-11	2011-12	2012-13	Mean
LR	Public	85.99%	89.92%	87.59%	80.43%	80.18%	84.82%
	Private	55.51%	64.62%	73.07%	73.32%	69.33%	67.17%
ER	Public	34.52%	35.83%	36.74%	30.52%	31.26%	33.77%
	Private	85.61%	38.09%	34.63%	30.42%	27.50%	43.25%
CoR	Public	120.51%	125.75%	124.33%	110.96%	111.44%	118.60%
	Private	141.12%	102.71%	107.70%	103.74%	96.83%	110.42%
IIR	Public	30.18%	34.91%	35.51%	27.01%	27.99%	31.12%
	Private	23.36%	11.55%	10.72%	11.54%	13.70%	14.17%
NRR	Public	82.91%	82.54%	84.19%	85.86%	84.05%	83.91%
	Private	64.74%	68.98%	72.06%	73.46%	76.81%	71.21%
OR	Public	90.33%	90.84%	88.82%	83.95%	83.45%	87.48%
	Private	117.76%	91.15%	96.99%	92.20%	83.13%	96.25%
NER	Public	2.98%	7.05%	-1.11%	4.35%	8.41%	4.34%
	Private	-52.18%	-11.63%	-10.17%	-7.03%	2.80%	-15.64%
ROE	Public	1.59%	2.89%	-0.41%	2.88%	5.48%	2.49%
	Private	-6.54%	-5.47%	-9.70%	-7.38%	10.08%	-3.80%
URR	Public	-28.44%	-26.42%	-37.06%	-23.18%	-17.36%	-26.49%
	Private	-502.21%	-35.47%	-21.46%	-21.24%	-10.46%	-118.17%

Loss Ratio (LR): The loss ratio of public sector non-life insurance firms is greater than that of the private sector non-life insurance firms in the study period. The average loss ratio of all the public sector non-life insurers is 84.8% whereas that of private sector non-life insurers is 67.2%. Clearly, it shows considerable difference between the public and private sector non-life insurance firms. The reason for lower loss ratios of the private sector insurance firms is that the private sector non-life insurers have avoided the unprofitable motor business until recently and the public sector non-life insurers have been underwriting most of the commercial motor portfolio IMF Report (2013). Also, the increase in loss ratio of non-life insurers has been mainly due to the higher claims from health insurance segment also for both public and private sector non-life insurers (D&B Research Report 2013). An increase in third party motor insurance premium over the years by IRDA regulation has helped non-life insurers limit their loss ratio to some extent in 2011-12 and 2012-13. ICICI Lombard, IfficoTokio and Reliance general have high levels of loss ratio among the private sector non-life insurers.

Expense Ratio(ER): The loss ratio of public sector non-life insurance firms is less than that of the private sector non-life insurance firms in the study period. Operating expenses of public sector non-life insurers have been stabilized except minor changes due to many years of their established business operations. From the early years of reforms and privatization till to 2008-09, operational expenses increased as private non-life insurance firms have spent more on establishing network branches and agents, marketing & advertisements, commissions to increase their business and to compete in the market. Over the recent years, private non-life insurance firms have taken measures to reduce their operational expenses like efficient distribution systems like banc assurance, which helped them reducing their operating expenses over the recent years of business in line with the public sector non-life insurance firms. Bharti AXA and Universal Sampo are with higher levels of expense ratios than the other firms considerably.

Combined Ratio (CoR): The combined ratio of public sector non-life insurance firms is greater than that of the private sector non-life insurance firms in the study period. This is due to higher levels of loss ratio of public sector non-life insurance firms over the years. Also, as a whole, combined ratio has shown a declining trend and reached at 114.51% explaining that the non-life industry is still in stage of underwriting loss after a decade of continued reforms. BajajAllianz, CholamandalamMS, HDFC Ergo and ShriRam General have better values of combined ratio which is below 100%.

Underwriting Results Ratio (URR): The Underwriting Results Ratio of public sector non-life insurance firms is higher than that of the private sector non-life insurance firms in the study period. Leaving the value of the ratio in 2008-09, the average underwriting results ratio of private sector non-life insurance firms is -22.16% and that of public sector non-life insurance firms is -26.49%. Hence, the underwriting losses of public sector non-life insurance firms are higher than that of private sector non-life insurance firms. Except BhartiAXA, Future Generali, Reliance General and Universal Sampo, all the private sector non-life insurance firms have shown underwriting losses less than that of public non-life insurance firms. Underwriting losses of public non-life insurance firms have shown increase trend in 2010-11 and 2011-12, due to the provisioning requirements in the motor third-party liability segment and from the health insurance losses (Best's Special Report 2014). Overall, the firms have reported better values in 2012-2013 as the non-life insurance firms have concentrated to improve underwriting discipline, better control over claims, investment return and risk

management for improving business performance along with recovery phase of Indian economy.

Net Retention Ratio (NRR): The average net retention ratio of public sector non-life insurance firms is higher than that of private sector non-life insurance firms. The trend indicates that the private sector insurance firms have shown an increasing trend of net retention ratio, whereas public sector non-life insurance firms have shown a marginal increase in net retention ratio over the years. Usually, insurance firms with strong capital like public sector firms retain more of their book of business than the private sector firms with a weak capital. Because the private sector non-life insurance firms cede their book of business to reinsurance, which results in lower levels of net retention.

Investment Income Ratio (IIR): The Investment Income Ratio of public sector non-life insurance firms is higher than that of the private sector non-life insurance firms in the study period. This is due to the fact that the public sector non-life insurance firms have good investment portfolios, which have been generating better investment returns than the private sector non-life insurance firms over the years. Another reason for this is due to higher level of net retention ratio of public sector non-life insurance firms. Also, the financial crisis of 2008 has affected the investment portfolios of all the insurance companies that resulted in decreasing trend of the investment income ratio till 2011-12. It appears that the year 2012-13 is the year of recovery for investment income ratio across the insurance industry. This is due to the recovery phase of Indian economy after the sluggish economic period of 2008-11(IMF WE Report 2013).

Operating Ratio (OR): The Operating Ratio of private sector non-life insurance firms is higher than that of the public sector non-life insurance firms in the study period. One of the reason for this is higher values of expense ratio as well as lower values of investment income ratio of private firms. It has been observed that the average operating ratio is less than 100% across public as well as private firms, results in operating profit from the underwriting and investment activities. Improvement in underwriting discipline and in investment management helps in better operating ratios. BhartiAXA, Future Generali and Iffico Tokio have operating ratios higher than 100%.

Net Earnings Ratio (NER): The average net earnings ratio of public sector non-life insurance firms is higher than that of the private sector non-life insurance firms in the study period. In fact, the decreasing profit after tax has been attributed to the decrease in net earnings ratio in

2010-11 and 2011-12, due to the provisioning requirements in the motor third-party liability segment and from the health insurance losses (Best's Special Report 2014). The net earnings ratio values of public as well as private firms have improved over the period under study. The reason for the improvement is because of reduction in expenses and moderate increase in the incurred claims over the period. This implies that the firms have started making profit out of the net written premium in recent years.

Return of Equity (ROE): The average ROE of public sector non-life insurers is higher than that of private sector firms. In fact, the decreasing profit after tax has been attributed to the decrease in net earnings ratio in 2010-11 and 2011-12, due to the provisioning requirements in the motor third-party liability segment and from the health insurance losses (Best's Special Report 2014). Also, the higher investment income of the public sector firms compensate their underwriting losses and that in turn helps in realising better operating, net earnings and ROE ratios. Clearly, private firms have to enhance their investment income and profits in the short run may be by increasing their net retention and/or capital as the case may be. But the investment returns are not certain and consistent, both the public and private firms have to concentrate to improve underwriting discipline to achieve higher levels of profitability in the long run. The ROE of public as well as private firms have improved over the period under study. The reason for the improvement is because of reduction in expenses and moderate increase in the incurred claims over the period. This implies that the firms have started making profit out of the net worth in recent years. In the year 2012-13, private firms have ROE of 10.8%, whereas public firms have 5.48%. It can be inferred that the private firms have shown better loss ratio as well as combined ratio which in turn resulted in decline of the underwriting losses.

5.2 Evaluation and Ranking using GRA and TOPSIS

The actual profitability ratios for evaluation, ranking of Indian non-life insurance firms and associated findings using Grey Relational Analysis (GRA) and TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) are discussed in this section.

5.2.1 Results from GRA Modelling

Based on the following criteria type (cost, benefit or moderate) as in Table 3, for each of the insurance firm by financial year, grey relational grade is determined and associated ranks are obtained. Also, the average grey relational grade is calculated by taking the average of the

grey relational grade for each of the insurance firm for all the financial years and corresponding rank is determined.

Table 3: Ratio and Criteria Type-GRA

Criteria	Type	Value
Loss Ratio	Smaller the better	Min
Expense Ratio	Smaller the better	Min
Combined Ratio	Smaller the better	Min
Investment Income Ratio	Higher the better	Max
Net Retention Ratio	Moderate the better or Observed Value (obv)	obv
Operating Ratio	Smaller the better	Min
Net Earnings Ratio	Higher the better	Max
ROE	Higher the better	Max
UW Results Ratio	Higher the better	Max

The grey relational grades for each of the insurance firms for all the years is as follows

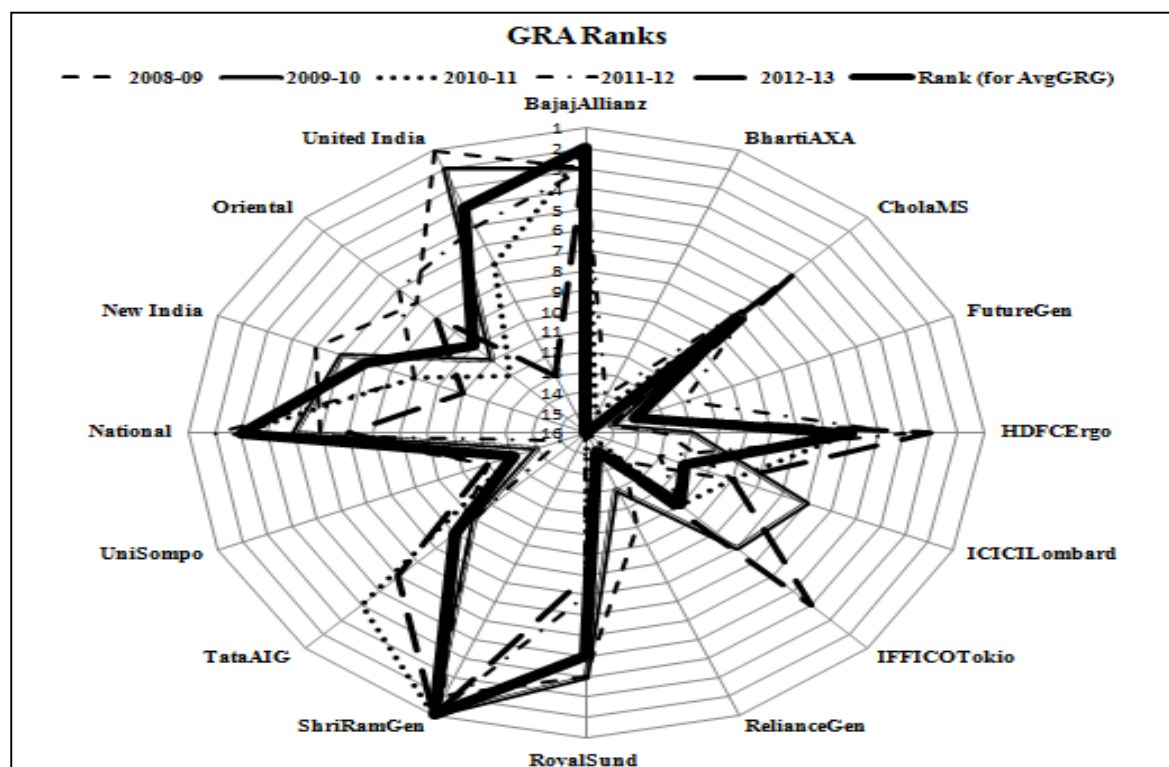
Table4: Grey Relational Grades for all the years with Average GRG

Firm /GRG	2008-09	2009-10	2010-11	2011-12	2012-13	Average GRG
BajajAllianz	0.850	0.793	0.802	0.803	0.784	0.806
BhartiAXA	0.594	0.563	0.610	0.653	0.548	0.594
CholaMS	0.815	0.731	0.757	0.770	0.734	0.762
FutureGen	0.753	0.620	0.631	0.705	0.623	0.666
HDFCErgo	0.768	0.710	0.771	0.791	0.784	0.765
ICICILombard	0.801	0.760	0.743	0.693	0.697	0.739
IFFICOTokio	0.768	0.746	0.735	0.706	0.758	0.743
RelianceGen	0.799	0.706	0.566	0.563	0.578	0.642
RoyalSund	0.847	0.789	0.773	0.765	0.697	0.774
ShriRamGen	0.854	0.875	0.896	0.888	0.922	0.887
TataAIG	0.813	0.721	0.777	0.750	0.732	0.759
UniSompo	0.787	0.693	0.636	0.601	0.663	0.676
National	0.831	0.785	0.789	0.807	0.716	0.786
New India	0.843	0.779	0.753	0.754	0.685	0.763
Oriental	0.817	0.714	0.733	0.773	0.698	0.747
United India	0.860	0.828	0.761	0.788	0.663	0.780

The ranks based on the grey relational grades of the insurance firms for all the years is as follows

Table5: Ranks based on GRG for all the years

Firm/Rank	2008-09	2009-10	2010-11	2011-12	2012-13	Rank (for Avg.GRG)
BajajAllianz	3	3	2	3	2	2
BhartiAXA	16	16	15	14	16	16
CholaMS	8	9	8	7	5	8
FutureGen	15	15	14	12	14	14
HDFCErgo	13	12	6	4	3	6
ICICILombard	10	7	10	13	10	12
IFFICOTokio	14	8	11	11	4	11
RelianceGen	11	13	16	16	15	15
RoyalSund	4	4	5	8	9	5
ShriRamGen	2	1	1	1	1	1
TataAIG	9	10	4	10	6	9
UniSompo	12	14	13	15	12	13
National	6	5	3	2	7	3
New India	5	6	9	9	11	7
Oriental	7	11	12	6	8	10
United India	1	2	7	5	13	4

Figure1: GRA Ranks**Table 6: Order of the firms based on Ranks for the Years 2008-2013**

Firm /Order	2008-09 Order	2009-10 Order	2010-11 Order	2011-12 Order	2012-13 Order	Order (Based on Avg.GRG)
1	United India	ShriRamGen	ShriRamGen	ShriRamGen	ShriRamGen	ShriRamGen
2	ShriRamGen	United India	BajajAllianz	National	BajajAllianz	BajajAllianz
3	BajajAllianz	BajajAllianz	National	BajajAllianz	HDFCErgo	National
4	RoyalSund	RoyalSund	TataAIG	HDFCErgo	IFFICOTokio	United India
5	New India	National	RoyalSund	United India	CholaMS	RoyalSund
6	National	New India	HDFCErgo	Oriental	TataAIG	HDFCErgo
7	Oriental	ICICILombard	United India	CholaMS	National	New India
8	CholaMS	IFFICOTokio	CholaMS	RoyalSund	Oriental	CholaMS
9	TataAIG	CholaMS	New India	New India	RoyalSund	TataAIG
10	ICICILombard	TataAIG	ICICILombard	TataAIG	ICICILombard	Oriental
11	RelianceGen	Oriental	IFFICOTokio	IFFICOTokio	New India	IFFICOTokio
12	UniSompo	HDFCErgo	Oriental	FutureGen	UniSompo	ICICILombard
13	HDFCErgo	RelianceGen	UniSompo	ICICILombard	United India	UniSompo
14	IFFICOTokio	UniSompo	FutureGen	BhartiAXA	FutureGen	FutureGen
15	FutureGen	FutureGen	BhartiAXA	UniSompo	RelianceGen	RelianceGen
16	BhartiAXA	BhartiAXA	RelianceGen	RelianceGen	BhartiAXA	BhartiAXA

Overall, the top profitable firms based on the criteria selected over the study period are Shri Ram General, Bajaj Allianz, National, United India and Royal Sundaram. The firms HDFC Ergo, Iffico Tokio and CholaMS have moved up the ladder of profitability by 2012-13. The firms Bharti AXA, Future Generali, Reliance General and Universal Sompo are with lower profitability levels over the years. The remaining firms Tata AIG, New India, Oriental and ICICI Lombard are with moderate levels of profitability over the years based on the criteria selected.

It has been observed that the most profitable firms have lowest grey relational grades in cost type criteria and highest to better grey relational grades in benefit and moderate type criteria and in case of non-profitable firms, the scenario is other way round. To be profitable, the firms have to control expenses, better manage claims, enhance their underwriting discipline and minimize other operating costs.

5.2.2 Results from TOPSIS Modelling

Based on the criteria type as given in Table 7, for each of the financial year, relative closeness is determined and associated ranks are obtained. Also, the average relative closeness is calculated by taking the average of all the relative closeness values for each of the insurance

firm for all the financial years and corresponding rank is determined based on the following cost type criteria(minimum value) and benefit type criteria(maximum value)

Table7: Ratios and Criteria Type-TOPSIS

Criteria	Value
Loss Ratio	Min
Expense Ratio	Min
Combined Ratio	Min
Investment Income Ratio	Max
Net Retention Ratio	Max
Operating Ratio	Min
Net Earnings Ratio	Max
ROE	Max
UW Results Ratio	Max

The relative closeness scores for each of the insurance firms for all the years is as follows

Table 8: Relative Closeness Scores for all the years with Average RC

Firm/RC	2008-09 RC	2009-10 RC	2010-11 RC	2011-12 RC	2012-13 RC	Average RC
Bajaj Allianz	0.748	0.787	0.745	0.782	0.784	0.769
BhartiAXA	0.251	0.123	0.150	0.371	0.057	0.190
CholaMS	0.732	0.726	0.611	0.710	0.676	0.691
FutureGenerali	0.565	0.418	0.339	0.535	0.393	0.450
HDFCErgo	0.681	0.580	0.638	0.619	0.781	0.660
ICICILombard	0.734	0.794	0.658	0.299	0.727	0.642
IFFICOTokio	0.701	0.755	0.625	0.605	0.759	0.689
RelianceGeneral	0.698	0.681	0.221	0.287	0.273	0.432
RoyalSundaram	0.733	0.777	0.635	0.662	0.644	0.690
ShriRamGeneral	0.737	0.787	0.747	0.827	0.840	0.788
TataAIG	0.728	0.741	0.694	0.602	0.725	0.698
UniversalSompo	0.606	0.421	0.306	0.312	0.401	0.409
National	0.733	0.789	0.752	0.743	0.690	0.741
New India	0.755	0.777	0.704	0.685	0.611	0.706
Oriental	0.741	0.707	0.640	0.721	0.637	0.689
United India	0.782	0.847	0.735	0.753	0.629	0.749

The ranks based on the relative closeness scores of the insurance firms for all the years is as follows:

Table 9: Ranks based on RC Ranks for the Years 2008-2013

Firm/Rank	2008-09 Rank	2009-10 Rank	2010-11 Rank	2011-12 Rank	2012-13 Rank	Rank (Based on Avg.RC)
BajajAllianz	3	5	3	2	2	2
BhartiAXA	16	16	16	13	16	16
CholaMS	9	10	12	6	8	7
FutureGenerali	15	15	13	12	14	13
HDFCErgo	13	13	9	9	3	11
ICICILombard	6	2	7	15	5	12
IFFICOTokio	11	8	11	10	4	10
RelianceGeneral	12	12	15	16	15	14
RoyalSundaram	8	6	10	8	9	8
ShriRamGeneral	5	4	2	1	1	1
TataAIG	10	9	6	11	6	6
UniversalSompo	14	14	14	14	13	15
National	7	3	1	4	7	4
New India	2	7	5	7	12	5
Oriental	4	11	8	5	10	9
United India	1	1	4	3	11	3

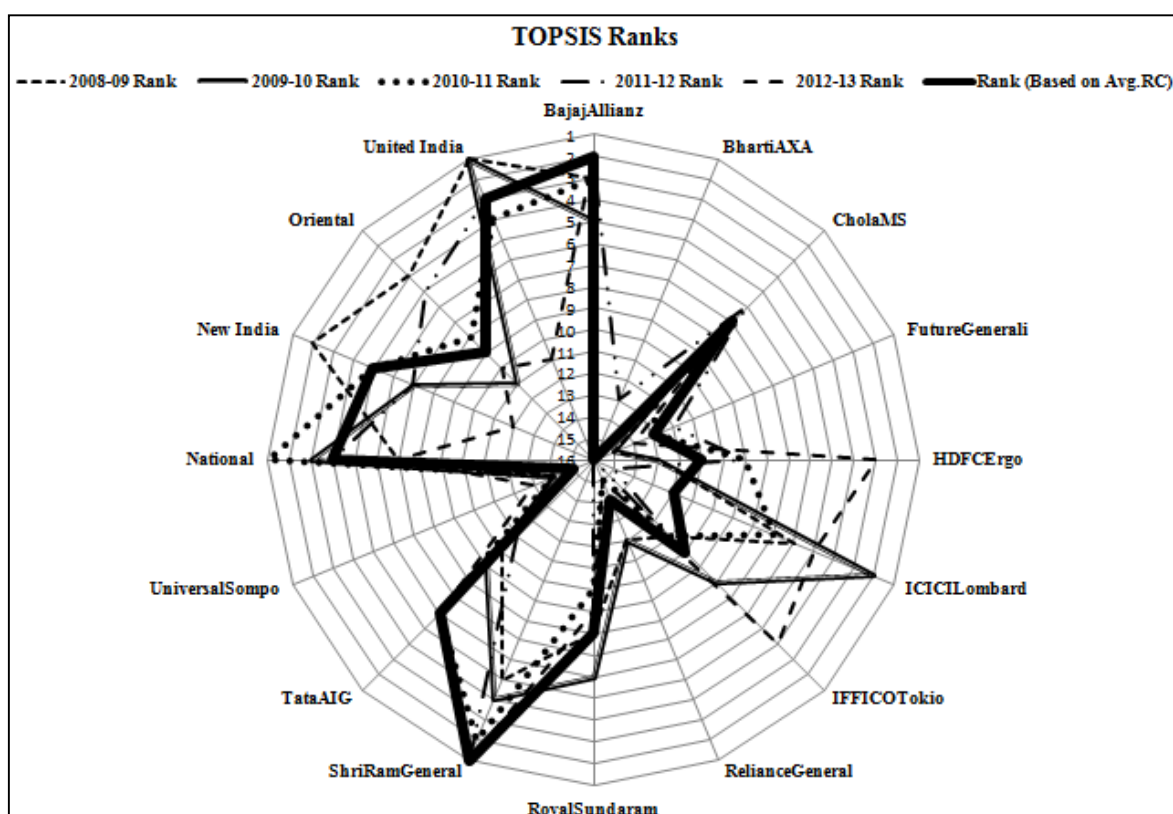
Figure 2: TOPSIS Ranks

Table10: Order of the firms based on Ranks for the Years 2008-2013

Rank	2008-09 Order	2009-10 Order	2010-11 Order	2011-12 Order	2012-13 Order	Order (Based on Avg.Rank)
1	United India	United India	National	ShriRamGen	ShriRamGen	ShriRamGen
2	New India	ICICILombard	ShriRamGen	BajajAllianz	BajajAllianz	BajajAllianz
3	BajajAllianz	National	BajajAllianz	United India	HDFCErgo	United India
4	Oriental	ShriRamGen	United India	National	IFFICOTokio	National
5	ShriRamGen	BajajAllianz	New India	Oriental	ICICILombard	New India
6	ICICILombard	RoyalSund	TataAIG	CholaMS	TataAIG	TataAIG
7	National	New India	ICICILombard	New India	National	CholaMS
8	RoyalSund	IFFICOTokio	Oriental	RoyalSund	CholaMS	RoyalSund
9	CholaMS	TataAIG	HDFCErgo	HDFCErgo	RoyalSund	Oriental
10	TataAIG	CholaMS	RoyalSund	IFFICOTokio	Oriental	IFFICOTokio
11	IFFICOTokio	Oriental	IFFICOTokio	TataAIG	United India	HDFCErgo
12	RelianceGen	RelianceGen	CholaMS	FutureGen	New India	ICICILombard
13	HDFCErgo	HDFCErgo	FutureGen	BhartiAXA	UniSompo	FutureGen
14	UniSompo	UniSompo	UniSompo	UniSompo	FutureGen	RelianceGen
15	FutureGen	FutureGen	RelianceGen	ICICILombard	RelianceGen	UniSompo
16	BhartiAXA	BhartiAXA	BhartiAXA	RelianceGen	BhartiAXA	BhartiAXA

Overall, the top profitable firms based on the criteria selected over the study period are Shri Ram General, Bajaj Allianz, National and United India. The firms HDFC Ergo, Iffico Tokio and CholaMS have moved up the ladder of profitability by 2012-13. The firms Bharti AXA, Future Generali, Reliance General and Universal Sompo are with lower profitability levels over the years. The remaining firms Tata AIG, New India, Oriental, Royal Sundaram and ICICI Lombard are with moderate levels of profitability over the years based on the criteria selected.

Now, GRA and TOPSIS ranks are compared by determining the Spearman's Rank Correlation for each of the year between the two methods

Table 11: Spearman's Rank Correlation between two methods

	TOPSIS						
	Year	2008-09	2009-10	2010-11	2011-12	2012-13	Avg
GRA	2008-09	0.89					
	2009-10		0.92				
	2010-11			0.83			
	2011-12				0.93		
	2012-13					0.94	
	Avg						0.91

From the Table 11, GRA and TOPSIS ranks are highly positive correlated. The minor deviations in their ranks are due to the methodological differences between the two methods. Overall, both the methods with similar ranks have revealed the consistency of Indian non -life insurance firm's profitability.

6. Conclusion

Loss Ratio, Combined Ratio, Underwriting Results Ratio, Net Retention Ratio, Investment Income Ratio, Net Earnings Ratio and Return of Equity of Public sector non-life insurance firms are greater than that of Private sector Non-life insurance firms. Whereas Expense ratio and Operating Ratio of Private sector non-life insurance firms are greater than that of Public sector non-life insurance firms is mainly due to higher level expenses and lower values of investment income ratio.

The reason for lower loss ratios of the private sector insurance firms is that they have avoided the unprofitable motor business until recently and the public sector non-life insurers have been underwriting most of the commercial motor portfolio. The increase in loss ratio of non-life insurers has been mainly due to the higher losses from health insurance segment across non-life industry and due to the provisioning requirements in the motor third-party liability segment.

Operating expenses of public sector non-life insurers have been stabilized except minor changes due to many years of their established business operations, it appears that public sector non-life insurers are conservative in their expansion of the business network. Till 2008-09, operational expenses increased as private non-life insurance firms have spent more on establishing network branches and agents, marketing & advertisements, commissions to increase their business and to compete in the market. Over the recent years, private non-life insurance firms have taken measures to reduce their operational expenses like efficient distribution systems like banc assurance and online marketing and/or selling, which helped them reducing their operating expenses of business in line with the public sector non-life insurance firms.

Higher levels of loss ratio made the of public sector non-life insurance firms to have higher values of combined ratio but as a whole and over the years combined ratio has shown a declining trend.

Private sector non-life insurance firms ceded their book of business to reinsurance more than that of public sector non-life insurance firms, which resulted in lower levels of net retention

but the trend indicates that the private sector insurance firms have shown an increasing trend of net retention ratio, whereas public sector non-life insurance firms have shown a marginal increase in net retention ratio over the years.

Public sector non-life insurance firms have good investment portfolios, which have been generating better investment returns than the private sector non-life insurance firms over the years. Another reason for this is due to higher level of net retention ratio of public sector non-life insurance firms. Also, the financial crisis of 2008 has affected the investment portfolios of all the insurance companies that resulted in decreasing trend of the investment income ratio till 2011-12. It appears that the year 2012-13 is the year of recovery, as the investment income ratio has shown little increase. Private firms have the higher values of operating ratio due to the lower values of investment income ratio and higher values of expenses

Decrease in net earnings ratio is attributed due to the decreasing profit after tax in 2010-11 and 2011-12 because of the provisioning requirements in the motor third-party liability segment and from the health insurance losses. The net earnings ratio values of public as well as private firms have improved over the period under study. The reason for the improvement is because of reduction in expenses and moderate increase in the incurred claims over the period. This implies that the firms have started making profit out of the net written premium in recent years.

ROE has strained across non-life industry in 2010-11 and 2011-12 due to the provisioning requirements in the motor third-party liability segment and health insurance losses. The ROE of public as well as private firms have improved over the period under study. Also, the higher investment income of the public sector firms compensate their underwriting losses and that in turn helps in realising better operating, net earnings and ROE ratios.

Clearly, private firms have to enhance their investment income and profits in the short run may be by increasing their net retention and/or capital as the case may be. As the investment returns are not certain and consistent, both the public and private firms have to concentrate to improve underwriting discipline to achieve higher levels of profitability in the long run.

Overall, the top profitable firms based on the criteria selected over the study period are Shri Ram General, Bajaj Allianz, National, United India and Royal Sundaram. The firms HDFC Ergo, Iffico Tokio and CholaMS have moved up the ladder of profitability by 2012-13. The firms Bharti AXA, Future Generali, Reliance General and Universal Sompo are with lower profitability levels over the years. The remaining firms Tata AIG, New India, Oriental and

ICICI Lombard are with moderate levels of profitability over the years based on the criteria selected.

Overall, the firms have reported better values in 2012-2013 as the non-life insurance firms have concentrated to improve underwriting discipline, better control over claims, investment return and risk management for improving business performance and secondly due to recovery phase of Indian economy.

It has been observed that the most profitable firms have lowest GRA grades in cost type criteria and highest to better grey relational grades in benefit and moderate type criteria and in case of non-profitable firms, the scenario is other way round. To be profitable, the firms have to reduce expenses, better claims management, enhance their underwriting discipline and minimize operating costs. The insurance firms Bharti AXA, Universal Sompo, Future Generali, Reliance General, IfficoTokio have higher values in cost type criteria made them to be at the bottom end in terms of profitability.

GRA and TOPSIS ranks are highly positive correlated and revealed the consistency of the Indian non-life insurance firm's profitability.

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